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CONSTANT BIAS DIODE DETECTOR CIRCUIT

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Fig. 1

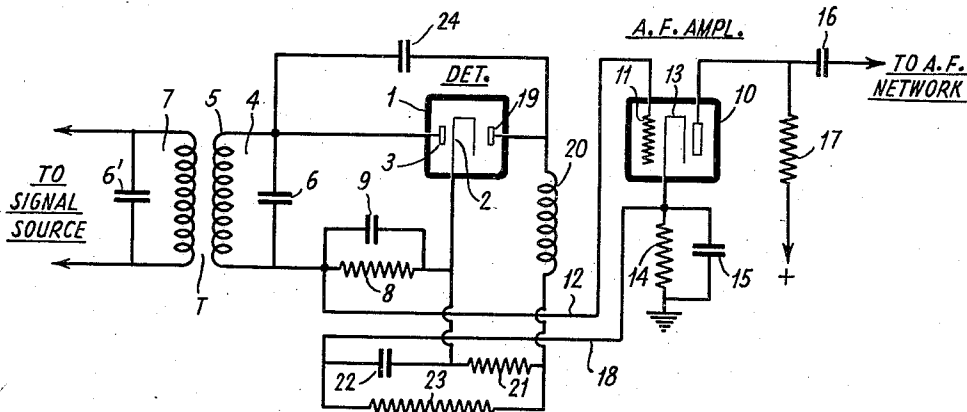


Fig. 2

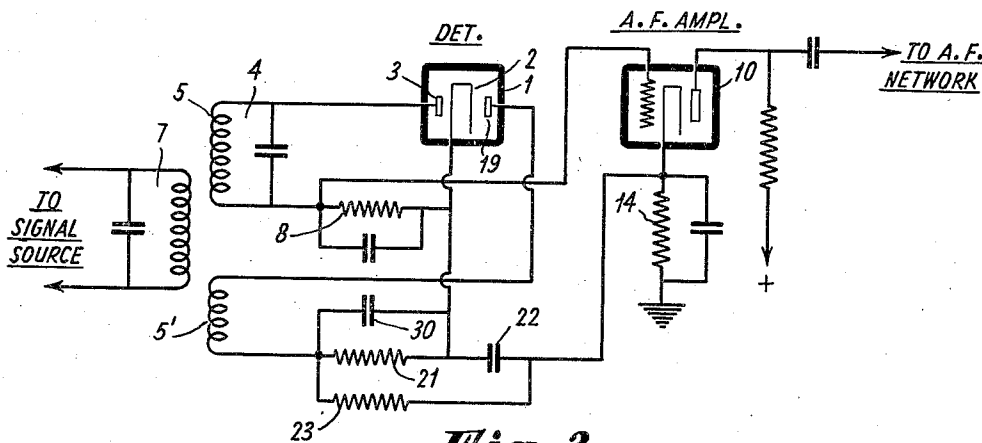
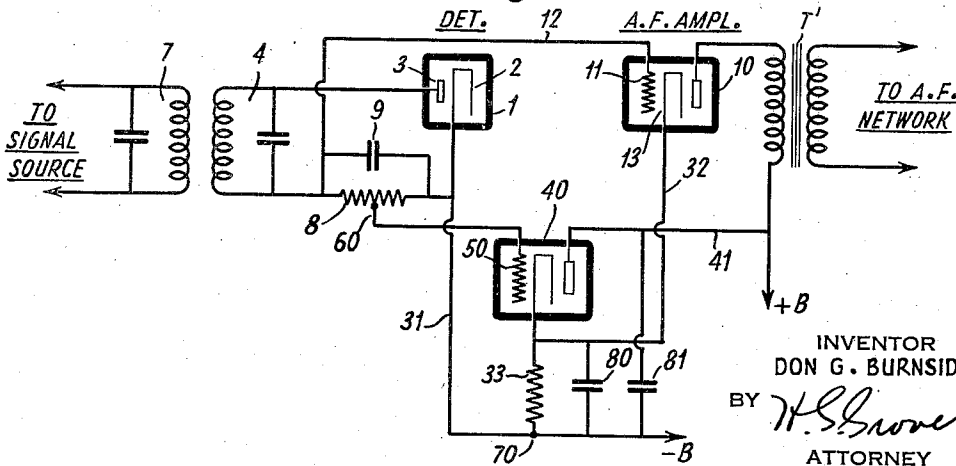


Fig. 3



UNITED STATES PATENT OFFICE

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CONSTANT BIAS DIODE DETECTOR CIRCUIT

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5 Claims. (Cl. 250—27)

My present invention relates to detecting-amplifying networks, and more particularly to an audio amplifier circuit arranged to be fed by a diode detector with constant bias.

5 It is the established practice to transmit the audio voltage developed by a diode detector to a following audio amplifier tube through a capacitor. This amplifier may be part of a combination diode and amplifier, as the 55 or duplex diode-triode type of tube, or it may be a separate unit. Whenever capacity coupling is employed it is necessary to utilize a grid resistor in the input circuit of the audio amplifier in order to maintain the input grid at some steady bias. 10 The grid resistor is in shunt to the diode load resistor, and is the cause of distortion when carrier signals of high modulation percentage are detected. When the audio amplifier grid is directly connected to the negative end of the diode load resistor, and no grid leak is used, the absence of an alternating current load permits detection of signals modulated to the order of 100% without cut-off distortion. Heretofore the serious defect in the directly connected grid arrangement 15 has been that the biasing voltage varies with carrier amplitude, and the grid voltage may be zero in the absence of carrier unless an initial bias is provided; or the biasing voltage may increase to cause amplifier plate current cut-off with strong carrier. Clearly, such a method is impracticable, except for a carrier of more or less fixed amplitude. 20

It may, therefore, be stated that it is one of the main objects of my present invention to employ the advantages inherent in a detector circuit employing a directly connected audio grid arrangement, and yet avoid the varying bias voltage arising with carrier amplitude variation. 25

Another important object is to reduce distortion in a detector-amplifier network, and particularly distortion due to operation on a non-linear portion of the characteristic for weak signals and cut-off distortion with strong signals. 30

Another important object of the invention is to avoid cut-off distortion in a network of the type which includes a diode detector having its load resistor directly connected to the audio grid of a following audio amplifier, and wherein a second diode is used which provides an equal and opposite voltage to maintain the audio grid at a constant bias regardless of carrier amplitude. 35

Another object of the invention may be stated to reside in the provision of a signal receiving system wherein the detector is of the diode type, and the following audio amplifier has its input 40

grid directly connected to a point on the detector load resistor; an auxiliary voltage source providing the normal operating bias for the audio grid and the varying biasing potential developed across the detector load resistor by varying carrier amplitude being substantially neutralized by a second diode detector circuit which is connected to the audio grid in such a manner that the neutralization is secured. 45

Still other objects of the invention are to improve generally the efficiency and reliability of a diode detector directly coupled to an audio amplifier and more especially to provide constant bias diode detector circuits which are not only reliable in operation, but economically manufactured and assembled in radio receivers. 50

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims; the invention itself, however, as to both its organization and method of operation will best be understood by reference to the following description taken in connection with the drawing in which I have indicated diagrammatically several circuit organizations whereby my invention may be carried into effect. 55

In the drawing:

Fig. 1 shows a circuit arrangement embodying one form of the invention, 30

Fig. 2 shows a modification of the arrangement in Fig. 1, and

Fig. 3 shows still another modification of the invention.

Referring now to the accompanying drawing, wherein like reference characters in the different figures designate similar circuit elements, the circuit arrangement shown in Fig. 1 comprises that portion of a signal receiving system which is essential to a proper understanding of the invention. It is to be understood that the receiving system in Fig. 1 may be of the superheterodyne type, or it may be of the tuned radio frequency amplifier type. In either case, the audio detector comprises a tube 1 having a cathode 2 and anode 3. The signal input circuit 4 includes the secondary winding 5 of input transformer T; the condenser 6 being connected in shunt across the winding 5 and tuning the circuit 4 to the operating signal frequency. The primary circuit 7 of transformer T is resonated to the same operating frequency, and, if the receiver is of the superheterodyne type, then it will be understood that circuits 4 and 7 are fixedly tuned to the operating I. F. Of course if the receiver is of the tuned radio frequency type, then the condensers 55

6 would be variable and have the rotors thereof arranged for mechanical uni-control adjustment with the rotors of the variable condensers in the preceding signal transmission stages.

5 It is not believed necessary to describe the various networks which precede the transformer T when the receiver is of the superheterodyne type. It is only believed necessary to point out that the circuit 7 will be disposed in the plate of the last I. F. amplifier tube, or in the plate of the first detector tube. Between the anode 10 of the last I. F. amplifier tube, or in the plate of the first detector tube. Between the anode 3 and cathode 2 is connected a series path which includes the tuned input circuit 4 and load resistor 8, the condenser 9 being connected in 15 shunt with resistor 8 and acting as an I. F. by-pass condenser. The audio amplifier 10 has its input grid 11 connected by the connection 12 to the anode terminal of load resistor 8. The cathode 13 of tube 10 is connected to ground 20 through the bias resistor 14, the by-pass condenser 15 being shunted across resistor 14. The amplified audio energy is transmitted through the audio coupling condenser 16 to the remainder of the audio utilization network, and the latter may comprise additional audio amplifiers, or 25 may be the final reproducer of the system. The plate of audio amplifier 10 may be connected to a desired positive potential source through the resistor 17; or through the primary of an audio 30 transformer where one is used.

The detector tube 1 includes within its envelope a second anode 19, the latter being connected to the cathode 2 through a path which includes the choke coil 20 and resistor 21. The 35 condenser 22 is connected between cathode 2 and cathode 13, and the resistor 23 is connected in shunt across resistor 21 and condenser 22. I. F. energy is impressed upon the diode anode 19 through a path which includes condenser 24; 40 and the latter is connected between the high alternating potential side of input circuit 4 and the anode side of choke coil 20. The lead 18 connects the junction of condenser 22 and resistor 23 to the cathode side of resistor 14.

45 The arrangement in Fig. 1 avoids the cut-off distortion which arises in prior arrangements when directly connecting the audio amplifier grid to a point on the load resistor. It will be seen that this is accomplished by employing a second diode that provides a carrier-derived biasing voltage which is equal and opposite in polarity to the biasing voltage causing distortion and derived from the diode detector. Both the audio voltage and direct current voltage developed across resistor 8 are passed directly to the grid 11 of audio amplifier 10. The same 50 I. F. voltage delivered to the diode 3—2 is impressed on the diode 2—19 by means of coupling condenser 24. The I. F. choke 20 prevents loss of I. F. voltage, but offers no resistance to the passage of direct current through it and through resistor 21; the latter resistor functioning as the load resistor for the rectification network which includes diode 2—19. The resistor 14 functions as the biasing resistor for 65 providing the fixed operating bias for the audio grid 11, and the direct current voltage developed across it is impressed upon the audio grid 11 through the path which includes connection 12, resistor 8, resistor 21 and resistor 23.

70 If resistors 8 and 21 are made of the same, or substantially the same, value, then the direct current voltage set up across these resistors are equal in magnitude. Since the audio grid 11 75 is connected to the cathode of tube 10 through

resistors 8 and 21, and since the direct current voltages across these resistors are in polarity opposition, it will be seen that the direct current voltages developed across resistors 8 and 21 cancel out insofar as the effect thereof on 5 audio grid 11 is concerned. In other words, the audio grid 11 will be maintained at a negative bias which depends solely upon the direct current voltage developed across resistor 14. The audio voltage developed in the detection process is impressed upon the audio amplifier through 10 two paths; one of these is the connection 12, and the other of these paths includes the larger condenser 22. The audio voltage across resistor 21 is suppressed so far as grid 11 is concerned. 15 If the condenser 22, being of relatively large capacitance, were shunted across resistor 21, the direct current voltage developed across the latter would be higher than that across resistor 8 when carrier signals of high modulation 20 percentage were received; reaching a value of twice that across resistor 8 when the modulation is equal to 100%. In order to prevent this resistor 23 is employed as a filter element to prevent condenser 22 from charging to the modulating signal peaks. The condenser 24 is small, 25 and is selected to have a relatively low impedance to the carrier signal only.

The arrangement in Fig. 2 differs from that shown in Fig. 1 in that the diode rectifier 19—2 30 is energized by a coil 5' which is coupled to the primary circuit 7. The circuit element designations in this modification correspond to similar ones in Fig. 1. It is noted, however, that condenser 30 is an I. F. by-pass condenser for resistor 21. It is not believed necessary to describe the modification of Fig. 2 in any further 35 detail, since it functions in exactly the same manner as the arrangement in Fig. 1. The sole exception resides in the fact that the I. F. energy 40 is impressed upon the rectifier network 2—19 by means of the magnetic coupling between the primary circuit 7 and the input coil 5'.

45 It is to be clearly understood that in the arrangement of Figs. 1 and 2 the double diode tube 1 may be replaced by a pair of independent diode tubes, and in that case the cathodes of the tubes would be at a common potential; for example, a tube of the 6H6 type can be employed. Furthermore, the audio amplifier 10 may be included within the same tube envelope as the 50 electrodes of the two diodes. In such a case, the cathode for the audio amplifier section would have to be independent of the common cathode of the two diodes. Furthermore, it is not essential to the present invention to utilize an auxiliary diode circuit to neutralize the carrier-derived voltage developed across the detector load resistor. 55

In Fig. 3 there is shown a circuit arrangement wherein the same result is secured by replacing 60 the auxiliary diode circuit with a circuit operating as a direct current voltage amplifier. In this circuit arrangement the audio grid 11 is connected through the lead 12 to the anode side of load resistor 8. The cathode 2 of the diode detector 1 is connected to the —B terminal of the direct current voltage supply source through lead 31. The cathode 13 of audio amplifier 10 is connected to the —B terminal through a path which includes lead 32 and the biasing resistor 33. The 70 plate of amplifier 10 is connected to the +B terminal through a path which includes the primary winding of the audio coupling transformer T'. The plate of tube 40 is connected by lead 41 to +B terminal, and the control grid 50 of 75

tube 40 is connected to a desired intermediate point on load resistor 8 through lead 60.

The initial bias for the grids of tubes 10 and 40 is supplied by the voltage drop across resistor 33.

5 With an incoming signal the direct current voltage drop across resistor 8 tends to drive the audio grid 11 more negative. The same voltage drop, or a suitable portion thereof, also makes the grid 50 more negative, and this in turn reduces the voltage drop across resistor 33. It will, therefore, be seen that the point 70 on biasing resistor 33 is in effect made more positive with respect to cathode 13, so that the voltage drop across biasing resistor 33 is equal and opposite in polarity to that across resistor 8. Hence under the influence of input signal energy, the grid 11 remains at a constant direct current potential with respect to cathode 13. The condensers 80 and 81 function to prevent amplification of audio signals by tube 40; the latter serves as a direct current amplifier.

Without in any way intending to restrict the scope of the present invention and merely by way of specific example and illustration, the following magnitudes are given for certain of the circuit elements of the aforescribed circuit arrangements;

Resistors 8 and 21=250,000 to 500,000 ohms.
 Resistor 23=250,000 ohms.
 30 Condensers 9, 24 and 30=100 to 200 m. m. f.
 Coil 20=50 millihenry low loss choke.
 Condenser 22=1.0 mf. or larger.

In Fig. 3, resistor 8 and condenser 9 may be of the same order of magnitude as the corresponding circuit elements in Fig. 1. The magnitude of resistor 33 depends on the characteristics of tubes 40 and 10. Condensers 80 and 81 should be of large capacity, of 2 mf. or more.

40 While I have indicated and described several systems for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organizations shown and described, but that many modifications may be made without departing from the scope of my invention as set forth in the appended claims.

What I claim is:

50 1. In combination with a diode detector of the type which includes a load resistor across which is developed audio and direct current voltage components from signals impressed on the detector circuit, an audio amplifier including at least a cathode, an input grid and an output electrode, means for impressing the said voltage components upon said audio grid, and additional means, responsive to signal carrier amplitude voltage at the detector input circuit, for substantially neutralizing a change in said direct current voltage component, said last means comprising an electron discharge device adapted to produce a direct current voltage which has a magnitude equal to a change in said direct current voltage component, but is of opposite polarity.

65 2. In combination with a diode detector of the type which includes a load resistor across which is developed audio and direct current voltage components from signals impressed on the detector

circuit, an audio amplifier including at least a cathode, an input grid and an output electrode, means for impressing the said voltage components upon said audio grid, and additional means, responsive to signal carrier amplitude voltage at the detector input circuit, for substantially neutralizing a change in said direct current voltage component, said last means comprising a second rectifier circuit which includes a second load resistor developing a direct current voltage from impressed signals, and which second direct current voltage is of a magnitude equal to said first direct current voltage but is of opposite polarity, and means for establishing said audio grid at a desired negative bias with respect to the audio amplifier cathode.

3. In combination with a diode detector circuit adapted to produce an audio voltage and direct current voltage from impressed signals, an audio amplifier having its input electrodes connected to the detector circuit for utilizing the audio and direct current voltages, a second rectifier circuit adapted to produce a direct current voltage from impressed signals, an auxiliary direct current voltage source for maintaining the audio amplifier input electrodes at a predetermined potential difference, and means for impressing the direct current voltage from the rectifier circuit upon said audio input electrodes in such a manner that the direct current voltages from both detector and rectifier circuits are in polarity opposition.

4. In combination with a diode detector of the type which includes a load resistor across which is developed audio and direct current voltage components from signals impressed on the detector circuit, an audio amplifier including at least a cathode, an input grid and an output electrode, means for impressing the said voltage components upon said audio grid, additional means responsive to signal carrier amplitude voltage at the detector input circuit, for substantially neutralizing a change in said direct current voltage component, said last means comprising an electron discharge tube having an impedance in its space current path across which is developed a direct current voltage, means for impressing at least a portion of the direct current voltage component upon the input electrodes of said last tube, and means for impressing the voltage developed across said impedance upon the input electrodes of said audio amplifier in a polarity sense to neutralize said biasing potential change.

5. A method of operating a signal receiving system of the type comprising a detector and an audio amplifier, which includes the steps of impressing the direct current and audio voltage components of detected signals upon said amplifier, establishing a predetermined potential difference between the input electrodes of said audio amplifier, deriving a second direct current voltage from impressed signals which is independent of the first direct current voltage, and impressing the second direct current voltage upon said audio amplifier in a polarity sense such as to counteract any tendency of said first direct current voltage to change said predetermined potential difference.

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